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JOURNAL OF SOUTH AFRICAN BOTANY

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A PRELIMINARY ACCOUNT OF THE NGOYE FOREST RESERVE, ZULULAND*

B. J. Huntley

(With Plates XXIX—XXXVII)

Abstract

The history, position and environmental factors of Ngoye Forest are described and its future discussed. The main plant communities and their inter-relationships are dealt with, special reference being made to the tropical affinities of both flora and fauna.

A simple management programme is recommended, whereby the Reserve would be conserved as a Scientific Research Area.

Introduction

In October, 1960, the author visited Ngoye Forest Reserve at the invitation of Messrs. I. F. Garland and K. H. Cooper. Since this date, several short visits and three fortnight-long collecting trips have been made.

This report is a summary of notes made on these visits.

The spelling given by Doke and Vilakazi (1953), i.e. "*Ngoye*, a range of hills and forest in Zululand", is correct. The use of all other spellings should be avoided. In this report Ngoye Forest Reserve is frequently referred to as "the Reserve".

Ngoye Forest Reserve is situated in south-east Zululand, at latitude 28° 50 'S, longitude 31° 42′ E (Fig. 1). The Reserve was proclaimed in terms of section five of Act No. 16 of 1913. The boundaries are demarcated in the field

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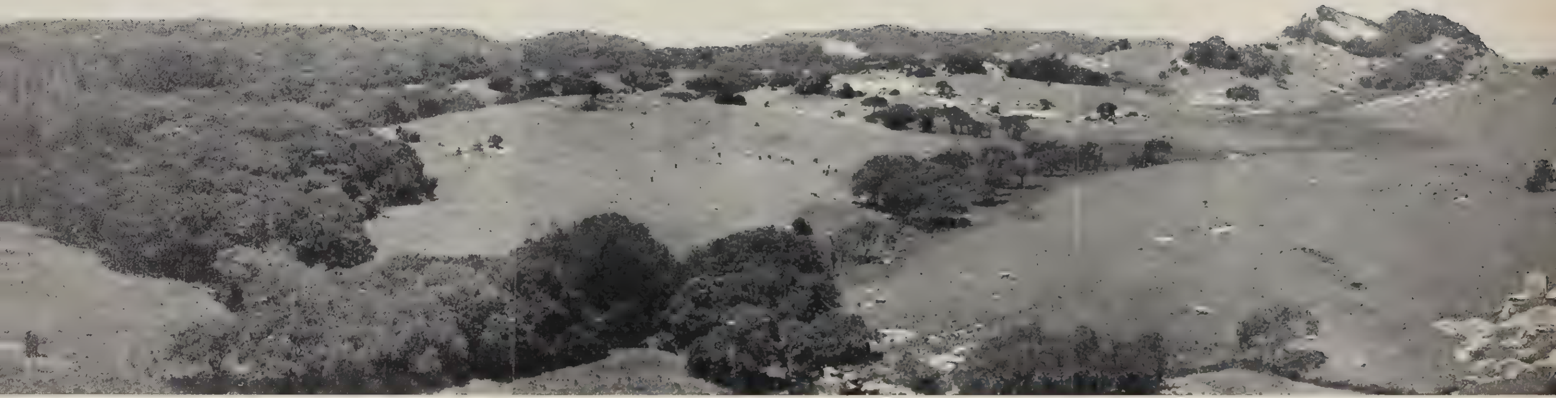

Plate XXIX
Panoramic View of various Plant Communities from Kwa-ndodinuka.

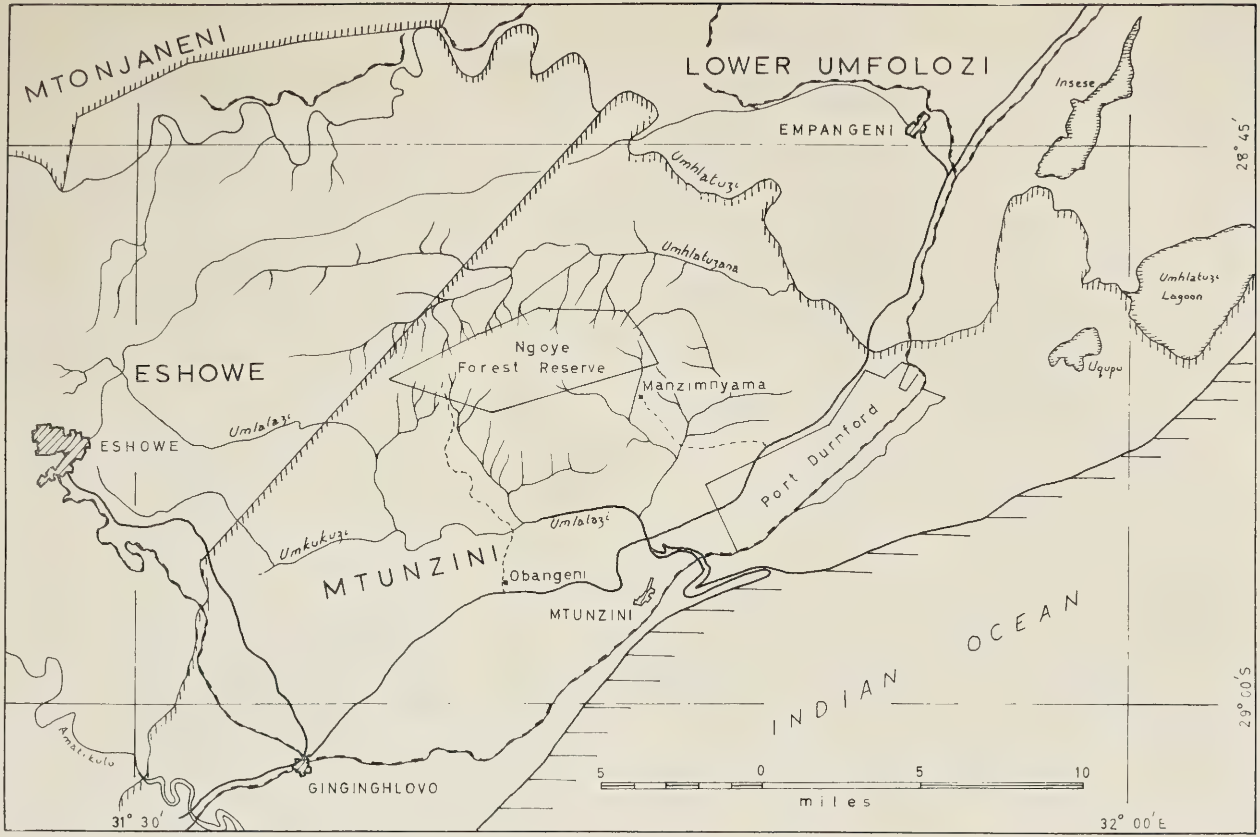

Fig. 1. Map of Mtunzini magisterial district showing position and drainage of Ngoye Forest Reserve.

by Forest Department Beacons 1 to 7. Native Reserve No. IX, proclaimed by the 3rd Interim Report of the Zululand Lands Delimitation Commission, 1903, surrounds the reserve.

The area is 9,648·6 acres of which approximately 7,000 acres is indigenous forest.

The Forest Guard camp at the Reserve may be approached by 4-wheel drive vehicles from Port Durnford Plantation by a very rough track, the trip of ten miles taking over an hour. The repair of an alternative route, following the old Ngoye Forest Company road via Manzimnyama School, is recommended.

The south-western extreme of the Reserve may be reached by 4-wheel drive vehicles via Obanjeni Store.

PHYSICAL FACTORS

Physiography

The Ngoye Range is described by McCarthy (1961) as an upfaulted horst of Basement Complex rocks bounded by the Umhlatuzi and Umlalazi Faults, to the north and south of which lie downfaulted Cape and Karoo system sediments.

The Basement Complex rocks at Ngoye comprise two main types, biotite granite gneiss and hornblend biotite schist; the former very resistant rock is overlain by the latter which is more easily weathered. Differential weathering of the two rocks has resulted in a sharply defined scarp at their southern confluence. Most of the forest is on the biotite granite gneiss at an altitude of 1,000 to 1,500 feet above sea level.

The range is drained by the Umhlatuzana River and its tributaries to the north and by the Umlalazi River and its tributaries to the south. Jointing of the biotite granite gneiss has resulted in a rectangular drainage pattern of the deeply incised forest streams.

Climate

Climatic data for the Reserve are not available, but the climate is almost identical with that of Eshowe, about 15 miles to the west, for which temperature and rainfall recordings are presented in Fig. 2.

The mean annual temperature is 19·6°C (67·08°F); an absolute maximum of 41·7°C (105·6°F) was recorded in 1941, and an absolute minimum of 2·3°C (36·14°F) in 1936.

The prevailing winds are from the north-east, associated with fine weather conditions; and from the south-west, which generally coincide with the passage of a low pressure trough and heavy rains. Wind damage to emergent forest trees is frequent, *Macaranga capensis* and *Millettia sutherlandii* being particularly susceptible. Despite the distance from the sea (approx. 7 miles), shearing

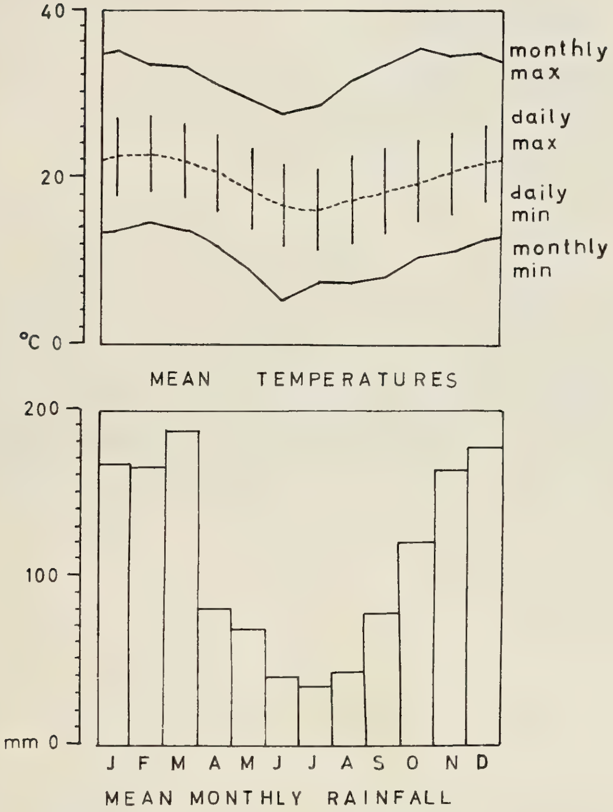

Fig. 2. Climatic data for Eshowe; lat. 28° 53′ S., long. 31° 28′ E. Alt. 530 m. Recording period 1921–1950.

of trees and shrubs by salt spray laden south-east winds is common on exposed sea facing slopes.

Rainfall distribution is distinctly seasonal; of the mean annual of 1,319 mm. (51·8 in.), 74% falls during the summer months of October to March. An absolute maximum of 2,335·5 mm. (91·5 in.) in 1925, and an absolute minimum of 763·8 mm. (30·0 in.) in 1931, have been recorded during the period 1921—1950.

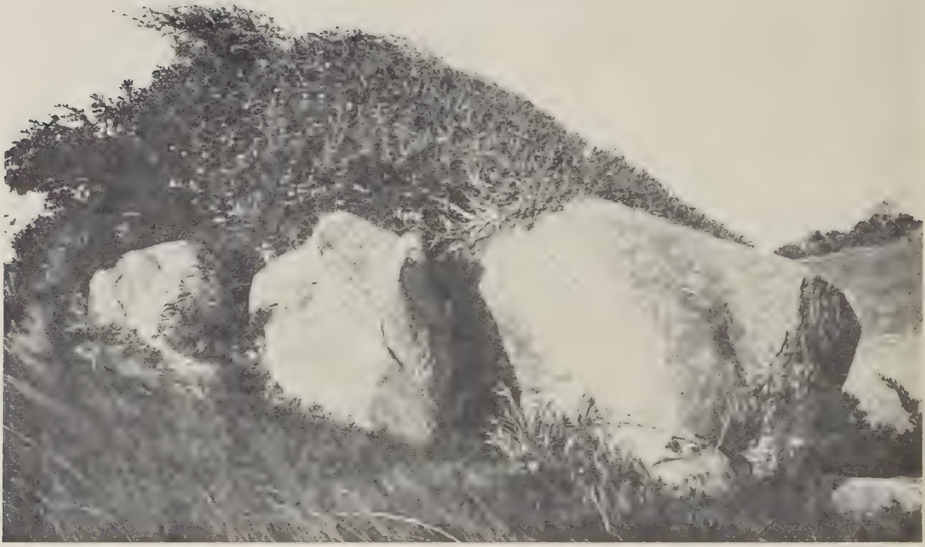

PLATE XXX
Wind-sheared *Ficus ingens* growing as chasmophyte on boulder outcrop. Prevailing wind south-east.

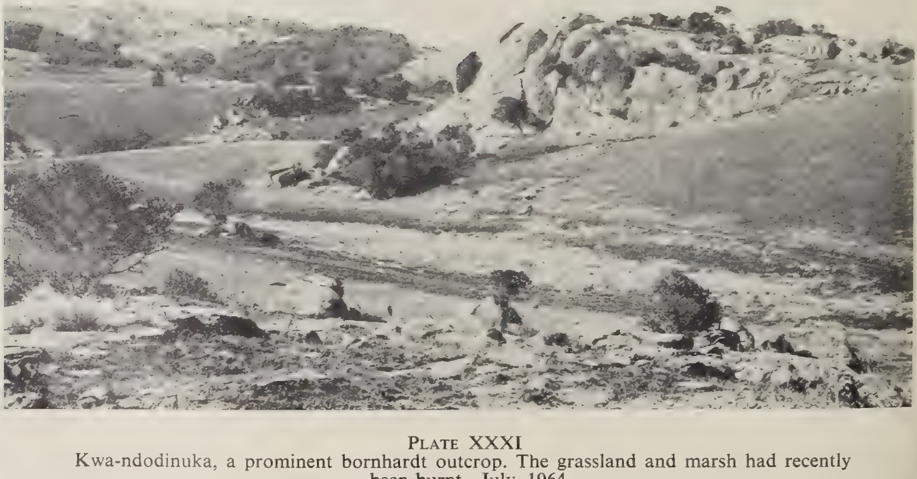

PLATE XXXI
Kwa-ndodinuka, a prominent bornhardt outcrop. The grassland and marsh had recently been burnt. July, 1964.

VEGETATION

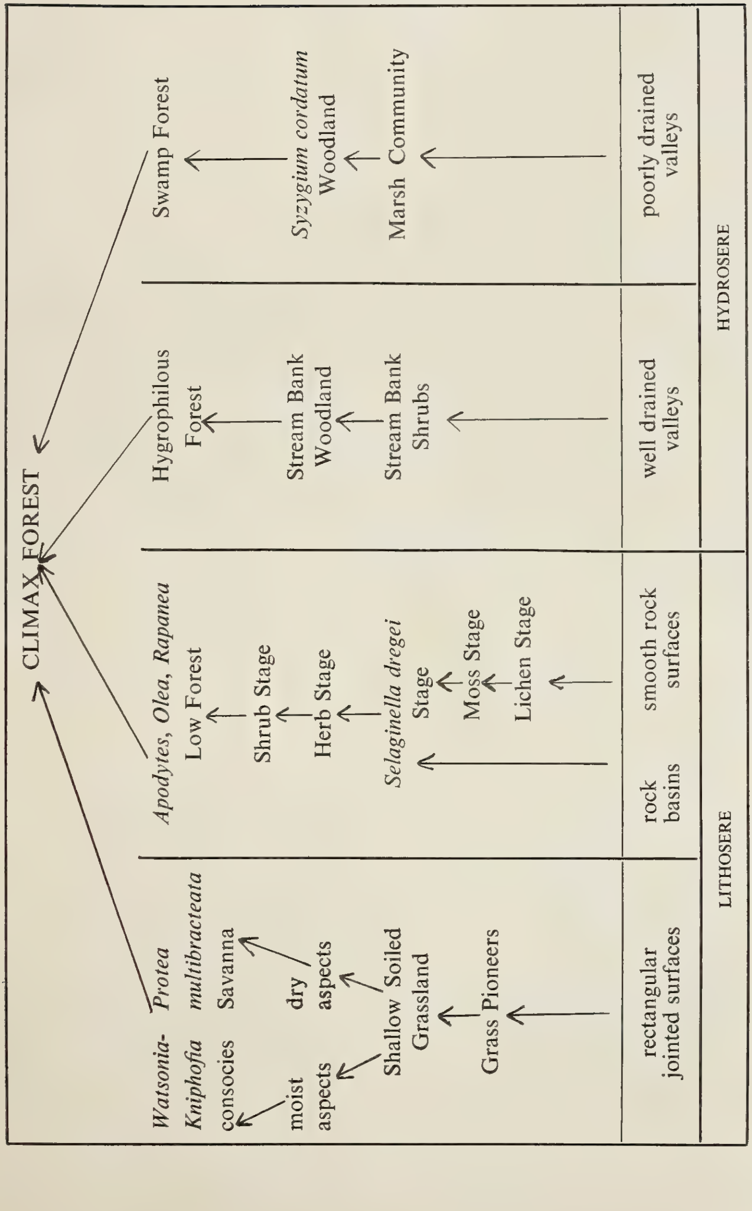

FIG. 3. Suggested interrelationships of main plant communities at Ngoye.

Notes on the plant communities are based in the main on qualitative observations, but several 20 ft. wide belt transects and three profile diagrams were compiled in order to obtain a quantitative assessment of various forest communities.

The species lists, unless otherwise stated, are compiled from material collected by the author in February and December 1963, and January and February 1964.

The suggested inter-relationships of the main seral communities are shown on Fig. 3.

Rock Outcrop Community

Plant succession on rock at Ngoye follows various courses depending on the character of the initial substrate. On smooth surfaces the following more important seral stages have been noted. The lichen stage is represented by crustose, foliose and fruticose lichens that occur as pioneers on smooth, bare rock surfaces. On the damper, cooler south-eastern slopes of the Khwezingqungqulu ridge this community is very well developed.

The moss stage is generally poorly developed, but on the mesocline of Swegogombe ridge mosses form fairly large mats.

The *Selaginella dregei* stage is well developed and forms dense mats which act as a substrate to the herbaceous stage. The mats contain rich invertebrate faunas. Baboons, ripping up the mats in search of food, cause extensive damage resulting in serious retardation of the succession. Where baboons have removed mats, the freshly exposed rock surface is pink in colour and very rough. It is possible that the acid soil water of the permanently moist pioneer colonies increases the chemical weathering of the biotite granite gneiss.

In some places weathering of biotite foliations and quartzofeldspathic veins has formed small rock basins. These basins are colonised by *Selaginella dregei*, without lichen and moss pioneers.

Key to Fig. 4:

Bm	Bridelia micrantha;	Lp	Linociera peglerae;
Bn	Bequaertiodendron natalensis;	Ml	Maesa lanceolata;
C	Carissa wyliei;	Mp	Microsorium punctatum;
Cd	Cyathea dregei;	Ms	Millettia sutherlandii;
Cf	Cassipourea gummiflua;	Pd	Podocarpus latifolius;
Cg	Cassipourea gerrardii;	Pr	Protorhus longifolius;
Cm	Cryptocarya myrtifolia;	Pz	Plectranthus zuluensis;
Cs	Cussonia spicata;	Oa	Ochna arborea;
Cw	Cryptocarya wyliei;	Rc	Rothmannia capensis;
Dg	Drypetes gerrardii;	Pa	Peddiea africana;
Fc	Fagara capensis;	Sa	Scleria angusta;
Fg	Flagellaria guineensis;	Sc	Syzygium cordatum;
Gc	Grumilea capensis;	Sh	Strychnos henningsii;
Gg	Garcinia gerrardii;	To	Turraea obtusifolia;
Hl	Halleria lucida;	Tv	Tabernaemontana ventricosa;
Im	Ilex mitis;	Vt	Voacanga thouarsii;

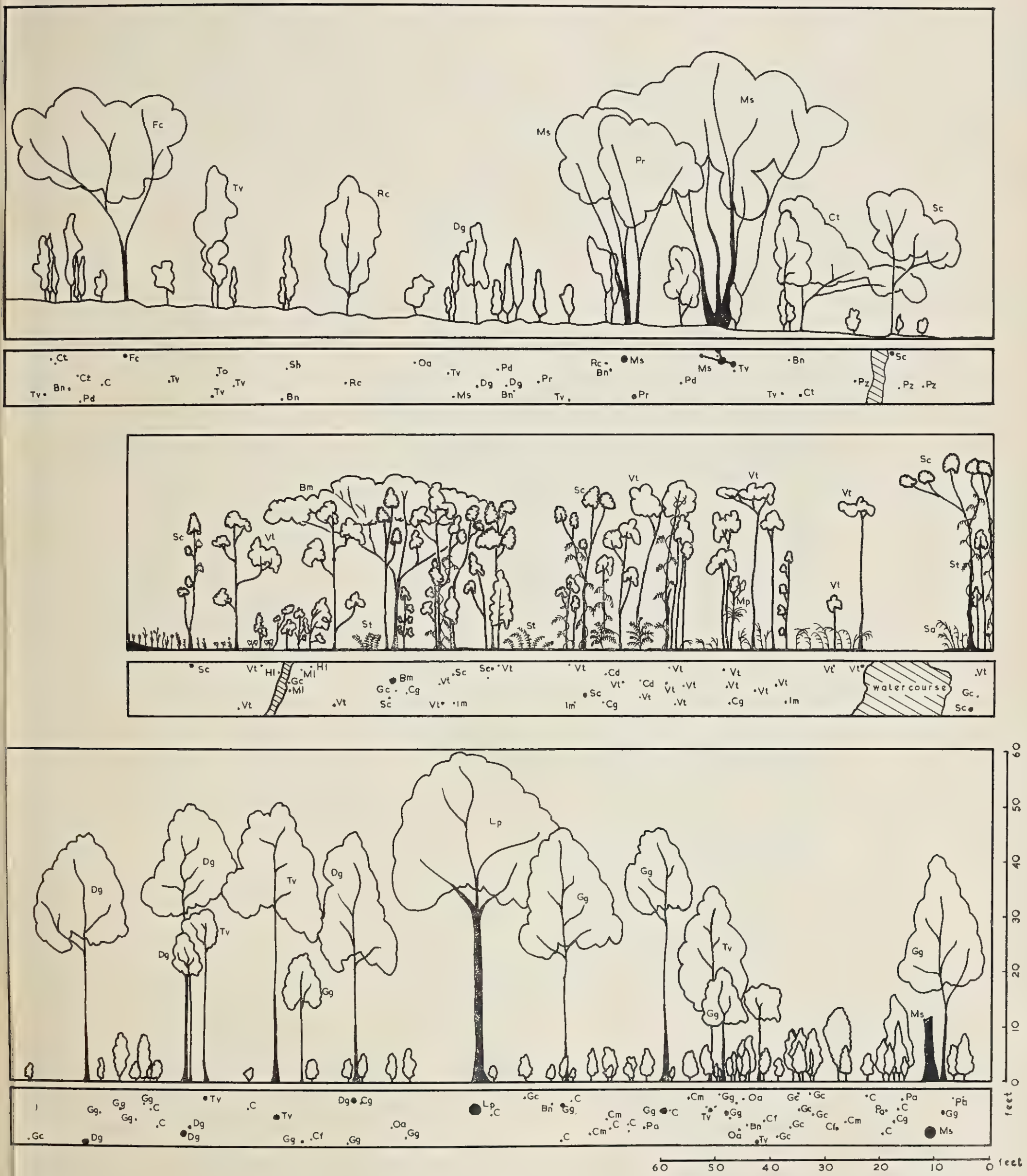

Fig. 4

Profile diagrams of: top, Forest Outlier Community; centre, Swamp Forest; bottom, Climax Forest. Each diagram represents a 10 ft. wide belt.

Early invaders of *Selaginella dregei* mats are short herbs up to 20 cm. tall, these including: the ferns *Asplenium rutaefolium*, *Pellaea calomelanos*, and *Phymatodes scolopendria;* the sedges *Bulbostylis contexta*, *B. humilis* and *Cyperus rupestris;* and the geophytes *Bulbine frutescens*, *Cyanotis nodiflora*, *Hypoxis filiformis* and *Scilla spp.* Taller herbs follow, including *Aeolanthus parvifolius*, *Cineraria atriplicifolia*, *Coleus sp.*, *Crassula ericoides*, *Helichrysum adenocarpum*, *Leontonyx tomentosa*, *Polygala rehmanni*, *Selago hyssopifolia*, *Senecio oxyodontus*, *Stachys grandifolia* and *Tritonia lineata*. Grasses include *Aristida junciformis*, *Eragrostis capensis*, *E. racemosa*, *Digitaria macroglossa*, and *Sporobolus africanus*.

The herbaceous stage is invaded by such shrub species as *Aloe arborescens*, *Anastrabe integerrima*, *Eugenia natalitia*, *Ficus ingens*, *Grumilea capensis*, *Hibiscus diversifolius*, *Maytenus acuminatus* and *Turraea obtusifolia*. Some of these species occur elsewhere as trees but on rock outcrops their growth is retarded by shallow soils.

With improving edaphic conditions, this shrub community, which attains a height of about 10 ft., gives way to a Low Forest Associes in which *Apodytes dimidiata*, *Olea capensis* and *Rapanea melanophloeos* are dominant.

This community has an uneven, discontinuous canopy, a well developed herbaceous field layer and many climbers. Trees range from 10 to 15 ft. in height, and include the dominants mentioned above and *Albizia adianthifolia*, *Cussonia spicata*, *C. umbellifera*, *Erythroxylum pictum*, *Harpephyllum caffrum*, *Millettia grandis*, *Mimusops obovata*, *Syzygium cordatum* and *Tarchonanthus camphoratus*.

The herb layer includes *Agapanthus patens*, *Clivia miniata*, *Kalanchoe sp.*, *Plectranthus sp.*, *Streptocarpus wendlandii* and *S. sp.*

Climbers include *Acridocarpus natalitius*, *Asparagus zuluensis*, *Buttonia natalensis*, *Dalbergia armata*, *D. obovata*, *Scutia myrtina*, and *Smilax kraussiana*.

The orchids *Cyrtorchis arcuata* and *Tridactyle bicaudata* are prolific in the deep humus of the margin to this associes.

A departure from the lithoseral succession as described above, occurs in areas where the rock is fissured. In certain areas the fissuring forms rectangular patterns. Grasses growing in these fissures include *Aristida junciformis*, *Cymbopogon validus*, *Hyparrhenia cymbaria*, *Rhynchelytrum setifolium*, *Schizachyrium semiberbe*, *Setaria sphacelata*, and *Sporobolus africanus*. Bare rock between the fissures is gradually covered over by humus and colonised by grasses and forbs.

In the damper areas of this grass community, associes of *Watsonia densiflora* and *Kniphofia gracilis* occur. In the drier areas, local *Protea multibracteata* Savanna may be present.

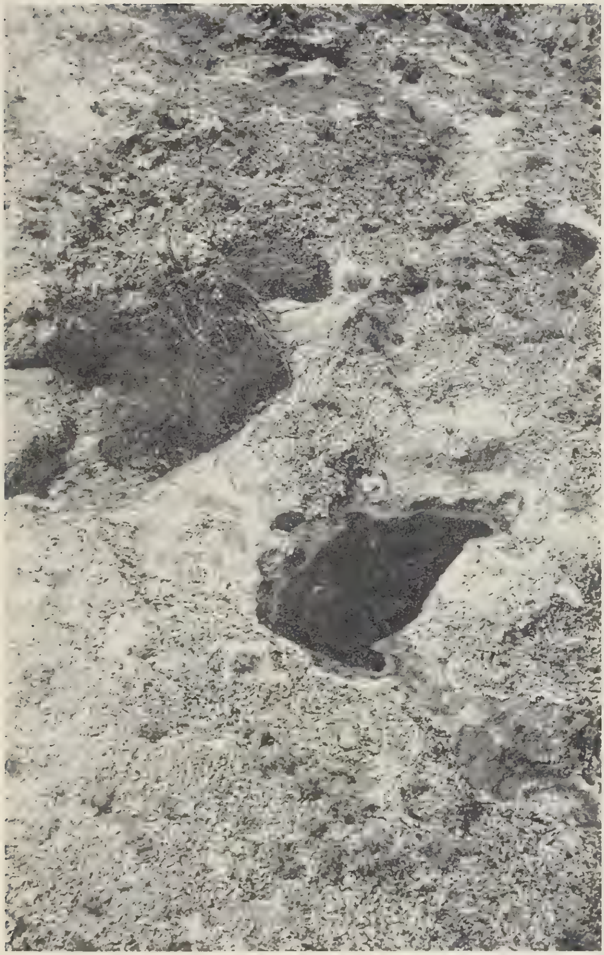

PLATE XXXII.

Crustose, foliose and fruticose lichens pioneering smooth rock surface. Note rock basins with accumulating soil and *Cyperus rupestris.* and *Hypoxis filifolius* colonizers. A small mat of *Selaginella dregei* may be seen to the right of *Hypoxis filifolius.*

Crevices on the bornhardt outcrops, filled with humus, are often directly colonised by trees and shrubs. *Ficus* species, including *F. burtt-davyii*, *F. capensis*, *F. ingens*, *F. polita*, *F. quibeba*, *F. soldanella* and *F. sonderi* are commonly found growing in this habitat. Other trees and shrubs occurring here include *Burchellia bubalina*, *Diospyros lucida*, *Eugenia natalitia*, *Grumilea capensis*, *Strelitzia nicolai* and *Tarchonanthus camphoratus*.

Grassland

The Reserve includes approximately 2,500 acres of grassland, approximately 1,200 acres of which covers the hills to the east of the Forest Guard camp, the remainder being spread in small patches around the forest perimeter. The floristic composition of the Grassland is mixed and in this respect differs markedly from the adjoining *Aristida junciformis* dominated Native Reserve.

The following species have been collected in the Reserve grassland: *Andropogon shirensis*, *Aristida junciformis*, *Digitaria macroglossa*, *Eragrostis capensis*, *E. racemosa*, *Hyparrhenia cymbaria*, *H. filipendula*, *Monocymbium ceresiiforme*, *Panicum dregeanum*, *P. natalensis*, *Paspalum commersonii*, *Schizachyrium semiberbe*, *Setaria sphacelata*, *Sporobolus africanus*, *Themeda triandra*, *Trachypogon plumosus* and *Tristachya hispida*.

The grassland forbs include: *Alepidea gracilis*, *Argyrolobium rupestre*, *Aristea gerrardii*, *Berkheya setifera*, *Cassia mimosoides*, *Cephalaria attenuata*, *Desmodium caffrum*, *D. hirtum*, *Dierama elatum*, *Eriosema cordatum*, *E. parviflorum*, *E. saligna*, *Habenaria dregeana*, *Helichrysum adscendens*, *H. appendiculatum*, *Indigofera eriocarpa*, *Lasiosiphon anthylloides*, *L. splendens*, *Lobelia erinus*, *Pentanisia angustifolia*, *Scabiosa columbaria*, *Scilla rigidifolius*, *Tephrosia canescens*, *T. glomeruliflora*, *T. macropoda*, *Thunbergia atriplicifolia*, *Wedelia menotriche*, *Xysmalobium undulatum*, *Zaluzianskya maritima* and *Zornia capensis*.

Root parasites include *Alectra orobanchoides*, *A. sessiliflora*, *Cycnium adonense* and *Striga bilabiata*.

Local socies of *Aristida junciformis*, *Encephalartos ngoyanus*, *Hyparrhenia filipendula*, *Kniphofia gracilis*, *Lasiosiphon splendens*, *Miscanthidium capensis*, *Stangeria eriopus* and *Watsonia densiflora* occur in the grassland.

Hydroseral Communities

The Ngoye Range is well drained by numerous fast flowing streams arising from valley-head springs. The major hydroseral communities studied may be discussed in two sections, (*a*) communities of the broader, poorly-drained valleys, and (*b*) vegetation lining the small fast flowing streams of the deeply incised valleys.

(*a*) *Poorly drained valleys*

The gentle slopes of the broader valleys are poorly drained and fairly extensive marsh communities occur. Sedges found here include *Cyperus immensus*, *C. isocladus*, *Fimbristylis complanata*, *F. dichotoma*, *Mariscus rivularis*, *Pycreus polystachyos*, *Rhynchospora sp.*, *Scirpus prolifer*, *Scleria angusta*, *S. melanomphala* and *Tetraria cuspidata*. Grasses include *Eulalia villosa*, *Ischaemum arcuatum* and *Setaria rigida*. Hygrophilous herbs are common and include *Buchnera dura*, *Eriocaulon sp.*, *Habenaria caffra*, *H. dregeana*, *Polygala capillaris*, *Sisyranthus imberbis*, *Thesium asterias*, *T. natalensis*, *Utricularia livida*, *U. prehensilis*, and *Xyris natalensis*.

Open *Syzygium cordatum* Woodland is present in some valleys. Associated trees include *Voacanga thouarsii* and *Rauwolffa caffra*. Shrubs occurring in this community include *Dissotis canescens*, *Stachys sp.*, and *Syncolostemon densiflorus*. *Aloe cooperi* and *Eulophia speciosa* occur in the more open parts.

The edaphic climax of the marsh hydrosere is the *Syzygium cordatum* and *Voacanga thouarsii* dominated Swamp Forest. The canopy at 25 to 35 ft. is dominated by *Syzygium cordatum* and *Voacanga thouarsii* with *Bridelia micrantha*, *Halleria lucida*, *Ilex mitis*, *Macaranga capensis* and *Tabernaemontana ventricosa* as associates.

Tall ferns of up to 7 ft. form a dense stratum comprising such species as *Cyathea dregei*, *Dryopteris gongylodes*, *Lonchitis pubescens* and *Stenochlaena tenuifolia*: The presence of *Cyathea dregei*, typically a heliophyte, in the Swamp Forest shrub layer, is of interest.

The tall sedge, *Scleria angusta* occurs in this stratum in which shrubs such as *Maesa lanceolata* and *Grumilea capensis* are found.

A herb layer is absent except on the margins of the Swamp Forest, where dense communities of *Plectranthus sp.* and *Zantedeschia sp.* may occur.

Climbers include the fern *Stenochlaena tenuifolia* and the armed woody climbers *Asparagus falcatus*, *Dalbergia armata* and *Entada spicata*.

Epiphytes are common, the orchids *Bulpophyllum sandersonii* and *Cyrtorchis arcuata* and the fern *Microsorium punctatum* have been noted.

An interesting ecological feature of this forest is the deep water-logged peat in which the plants grow. Physiognomic characters of the trees include the mats of ageotropic pneumatophores of *Voacanga thouarsii*, stilt roots of *Bridelia micrantha*, buttresses of *Macaranga capensis*, and knee roots of *Cassipourea gerrardii*.

(*b*) *Well drained valleys*

The deeper, better drained valleys have fast flowing streams which are lined with shrubs and trees forming an open, discontinuous Stream Bank Woodland. Shrubs include *Dissotis canescens*, *Gerrardina foliosa*, *Myrica conifera* and *Passerina sp.* Trees include *Bridelia micrantha*, *Erythroxylum pictum*, *Ficus* *capensis*, *Halleria lucida*, *Ilex mitis*, *Rauwolffa caffra*, *Syzygium cordatum* and the tree fern *Cyathea dregei.*

Stream Bank Woodland develops into Hygrophilous Forest in which *Croton sylvaticus* and *Macaranga capensis* dominate. Associated trees include those listed for the Stream Bank Woodland with *Rawsonia lucida* and *Oxyanthus gerrardii* in addition. The canopy of 30 ft. to 45 ft. is uneven and discontinuous. Shrubs in this forest include *Mackaya bella* and *Rothmannia globosa*, and suffrutices include *Justicia campylostemon*, *Piper capensis*, *Plectranthus zuluensis* and *Thunbergia natalensis.*

The banks of the larger streams lined with Hygrophilous Forest present a magnificent sight in summer when the many brightly coloured herbs are in flower. These include *Aneilema aequinoctiale*, *Begonia sp.*, *Clivia miniata*, *Commelina benghalensis*, *Crocosmia aurea*, *Dietes butcheriana*, *D. vegeta*, *Dracaena hookeriana*, *Haemanthus katherinae*, *Impatiens duthei*, *Streptocarpus wendlandii*, and *S. grandis.*

The orchid *Stenoglottis fimbriata*, the ferns *Microsorium punctatum* and *Vittaria isoetifolia* and the herb *Peperomia reflexa* occur as litho-or epiphytes.

Forest Margin

The seral communities from grassland to climax forest are very poorly developed on most of the 57 miles of forest margin.

Tall grasses of up to 7 ft. that occur on the forest margin include *Cymbopogon validus*, *Digitaria natalensis*, *Hyparrhenia cymbaria*, *Miscanthidium capensis*, *Setaria chevalieri* and *Sorghastrum rigidifolium.* Suffrutices and shrubs found here are *Arthrosolen calocephalus*, *Berkheya bipinnatifida*, *Crotolaria natalensis*, *Diospyros lucida*, *D. lycioides*, *Polygala virgata*, *Pseudarthria hookeri* and *Rhoicissus tridentata. Pteridium aquilinum*, the bracken fern, forms local consocies in damper areas of the forest margin.

Short trees up to 20 ft. occurring in the margin community include *Burchellia bubalina*, *Canthium mundtianum*, *Cassinopsis tinifolia*, *Dovyalis caffra*, *Garcinia livingstonii*, *Maesa lanceolata*, *Rhus fraseri*, *R. discolor*, *Vangueria infausta* and *Ximenia caffra.*

Trees of up to 50 ft. in height found on the forest margin include: *Albizia adianthifoïia*, *Bridelia micrantha*, *Croton sylvaticus*, *Cussonia spicata*, *C. umbellifera*, *Harpephyllum caffrum*, *Macaranga capensis*, *Protorhus longifolius*, *Rapanea melanophloeos*, *Rhus legati*, *Trema guineensis*, and *Vepris undulata.*

Numerous lianes make the forest margin almost impenetrable. Species recorded are: *Adenia gummifera*, *Asparagus falcatus*, *Dalbergia armata*, *D. obovata*, *Dioscorea dregeana*, *D. sylvatica*, *Flagellaria guineensis*, *Riocreuxia sp.*, *Rhoicissus rhomboidea*, *R. tomentosa*, *Sarcostemma viminale*, *Secamone frutescens*, *S. galpinii*, *Scutia myrtina*, *Smilax kraussiana*, *Strophanthus sp.*, and *Thunbergia dregeana.*

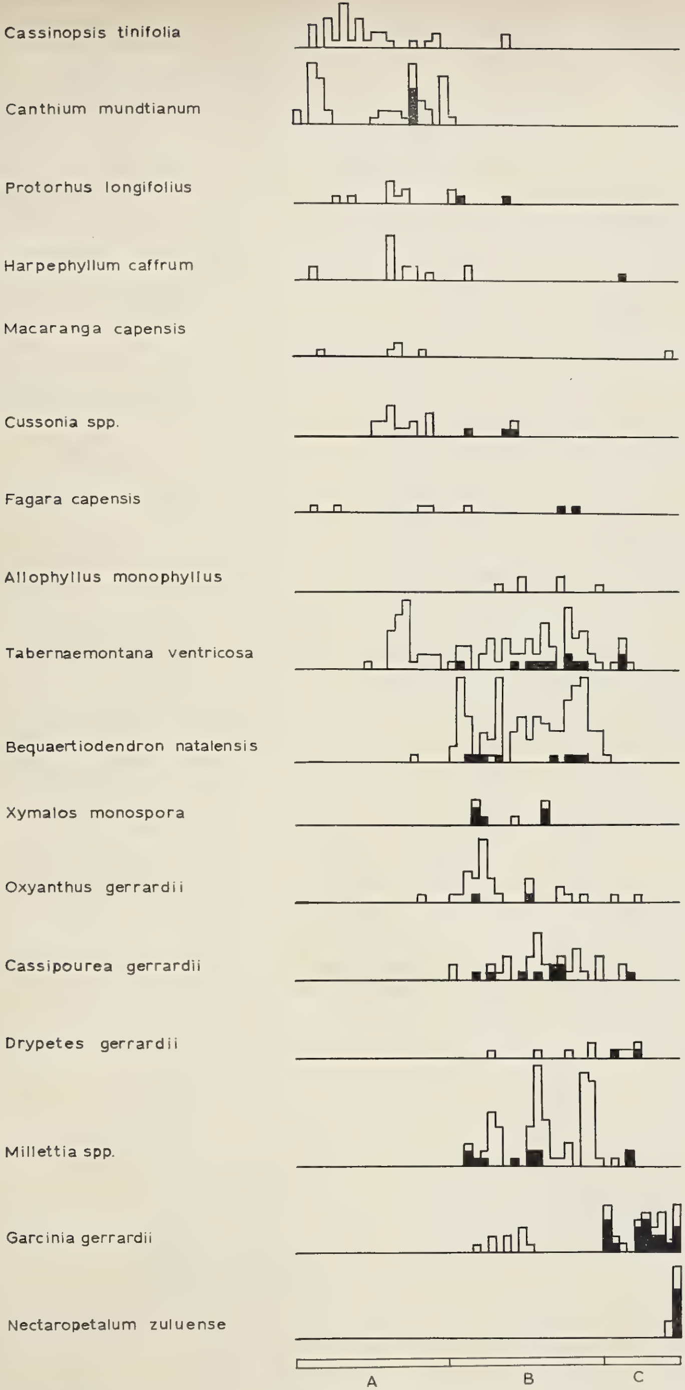

FIG. 5. Distribution of most frequent species recorded in 20 ft. wide belt transects through forest communities. Belt transect A (20 x 1,000 ft.) was through sample plots of *Cupressus lusitanicus*, *Eucalyptus saligna* and *Pinus patula*. Belt transect B, (20 x 1,000 ft.) through forest margin and secondary forest. Belt transect C (20 x 500 ft.) through Clunan Forest. Each block represents one stem recorded per 20 x 50 ft. section of the transects. Stems of more than 8 ins. diam. are indicated by shaded blocks.

The irregular canopy of the Forest Margin allows light to penetrate to the field and shrub layers which are consequently very dense. As shown in Figure 5, the stem diameters of Forest Margin trees are relatively smaller than those of the Climax Forest, but the density of stems and number of species occurring in the Forest Margin is far greater than in Climax Forest.

Climax Forest

Climax Forest is distinguished from forest margin and secondary forest communities by its continuous canopy, stratification with five recognisable strata, large size of trees, poorly developed shrub and field layers, paucity of lianes and abundance of epiphytes.

The tall trees rise above the general canopy, attaining 70 to 90 ft. Species include *Chrysophyllum viridifolium*, *Millettia sutherlandii* and *Podocarpus latifolius*. The emergent specimens of *Millettia sutherlandii* often have hollow boles and are susceptible to damage by strong winds, especially if they support a great weight of *Flagellaria guineensis*. Where trees of *Millettia* have been blown down, coppicing may occur, resulting in a multi-stemmed growth form. Damage to the surrounding forest caused by the death of old emergent trees results in local regeneration by light tolerant seedlings of forest margin species. This accounts for the appearance of such typically forest marginal species as *Albizia adianthifolia* as canopy trees deep within the Climax Forest.

The Upper Canopy stratum is continuous except where emergent species or fallen trees break through. It ranges from 45 to 65 ft. in height. The list of species included in this canopy is compiled from my observations supplemented by species recorded by Edwards and Wells (1961): *Antidesma venosum*, *Apodytes dimidiata*, *Brachylaena transvaalensis*, *Bridelia micrantha*, *Calodendrum capense*, *Casearia junodii*, *Celtis africana*, *Cryptocarya latifolia*, *Chrysophyllum viridifolium*, *Cussonia chartacea*, *C. umbellifera*, *Croton sylvaticus*, *Drypetes gerrardii*, *Ekebergia capensis*, *Fagara capensis*, *Ficus capensis*, *F. natalensis*, *F. petersii*, *F. polita*, *F. quibeba*, *Harpephyllum caffrum*, *Linociera peglerae*, *Macaranga capensis*, *Mimusops obovata*, *Nuxia floribunda*, *Olinia radiata*, *Podocarpus falcatus*, *P. latifolius*, *Protorhus longifolius*, *Pygeum africanum*, *Rapanea melanophloeos*, *Rauwolffa caffra*, *Scolopia mundtii*, *Scolopia zeyheri*, *Syzygium gerrardii*, *Strychnos henningsii*, *Trichilia emetica*, *Vepris undulata* and *Xymalos monospora*.

The subordinate tree stratum is from 15 to 45 ft. in height and may be divided into two classes, taller trees of 25 to 45 ft., and shorter trees of 15 to 25 ft. As my observations of this stratum are limited, the species list is again supplemented by the records of Edwards and Wells (1961).

Taller trees from 25 to 45 ft. include *Allophylus monophyllus*, *Bequaertiodendron natalensis*, *Cassipourea gerrardii*, *C. gummiflua var. verticillata*, *Cola natalensis*, *Garcinia gerrardii*, *Halleria lucida*, *Maytenus acuminatus*, *Ochna* *arborea*, *Nectaropetalum zuluense*, *Tabernaemontana ventricosa*, and *Trimeria rotundifolia*.

Shorter trees from 15 to 25 ft. include *Alchornea hirtella*, *Bersama lucens*, *Clausena anisata*, *Eugenia natalitia*, *Grumilea capensis*, *Oxyanthus gerrardii*, *Peddiea africana*, *Rawsonia lucida*, *Rothmannia capensis*, *Rinorea natalensis*, and *Tarenna pavettoides*.

The shrub layer is poorly developed in heavily shaded Climax Forest, but wherever a gap in the canopy allows light to penetrate, this community is very dense. The stratum, from 5 to 15 ft. includes such species as *Canthium ciliatum*, *Carissa bispinosa var. acuminata*, *C. wyliei*, *Cryptocarya wyliei*, *Dracaena hookeriana*, *Tricalysia lanceolata* and *Turraea obtusifolia*.

The field layer community, comprising herbs and grasses, is generally poorly developed. Species include: *Chlorophytum sp.*, *Clivia miniata*, *Conostomium natalense*, *Desmodium hirtum*, *D. repandum*, *Dietes vegeta*, *D. butcheriana*, *Haemanthus spp.*, *Isoglossa cooperi*, *Oplismenus hirtellus*, *Panicum laticomum*, *Pseudechinolaena polystachya*, *Olyra latifolia* and *Stangeria eriopus*.

Climbers are infrequent in the Climax Forest; those noted include *Behnia reticulata*, *Dalbergia obovata*, *Entada spicata*, and *Flagellaria guineensis*.

Epiphytes are common and have been noted as particularly abundant on *Harpephyllum caffrum*, *Linociera peglerae*, *Macaranga capensis*, *Podocarpus latifolius* and *Syzygium gerrardii*.

Epiphytic ferns include *Asplenium sandersonii*, *Microsorium punctatum*, *Polypodium sp.* and *Vittaria isoetifolia*.

Orchids are prolific on most large specimens of the trees mentioned above and include *Bolusiella maudae*, *Bulbophyllum sandersonii*, *Cyrtorchis arcuata*, *C. praetermissa*, *Diaphananthe xanthopollinium*, *Mystacidium sp.* and *Polystachya tesselata*.

Other angiospermous epiphytes include *Rhipsalis cassytha* (Cactaceae) *Dermatobotrys saundersii* (Scrophulariaceae) and *Streptocarpus daviesii* (Gesneriaceae).

Bryophyte and lichen epiphytes are particularly abundant but material collected has not yet been identified.

Hemiparasites are not common. *Viscum nervosum* occurs on *Garcinia gerrardii*, *Viscum wyliei* on *Rapanea melanophloeos*, *Loranthus woodii* on *Burchellia bubalina, and Loranthus quinquenervis* on *Erythroxylum pictum*.

Parasitic and saprophytic fungi are very common in the damper parts of the forest. The latter are responsible for the rapid decay of fallen trees and other vegetable material.

Physiognomy of the Climax Forest

Affinity with Tropical Rain Forest is evident from the Climax Forest physiognomy and is best illustrated by the abundance of buttress roots, fluted stems, "drip tips", cauliflorous flowers, and the presence of five recognisable strata.

Buttresses. Nearly all canopy and subordinate tree layer species at Ngoye exhibit some form of buttress. Plank buttresses are best developed in the larger specimens of *Drypetes gerrardii*, *Harpephyllum caffrum* and *Syzygium gerrardii* Plank buttresses have also been noted on *Cedrella odorata* (introduced), *Garcinia gerrardii*, *Linociera peglerae*, *Macaranga capensis*, *Millettia sutherlandii* and *Nectaropetalum zuluense*.

Harpephyllum caffrum especially, and to a lesser degree, *Nectaropetalum zuluense* and *Drypetes gerrardii*, frequently have long lateral roots running superficially on or above the ground. The superficial root system, buttresses, and the absence of tap roots noticed in large trees uprooted by wind, indicate the shallowness of the soil covering the parent rock.

Chrysophyllum viridifolium and *Drypetes gerrardii* generally have deeply fluted stems.

The bark of the forest trees varies considerably according to species. It may be up to 30 mm. thick in upper canopy specimens of *Cussonia chartacea*, or only a few mm. thick in *Ochna arborea* of the subordinate tree layer. The colour of the inner bark may be deep red as in the upper canopy species *Harpephyllum caffrum*, *Macaranga capensis* and *Bridelia micrantha*, or yellow as in *Garcinia gerrardii* of the subordinate tree layer. The sap may be watery red as in *Millettia sutherlandii*, viscous yellow as in *Garcinia gerrardii*, or white as in *Tabernaemontana ventricosa*.

A very small percentage of the shrubs and smaller forest trees have any form of spinescence. Of the larger trees *Scolopia zeyheri* has thorns of several cms. long on the old wood while the prickles on *Fagara capensis* may attain over 10 cm. in length.

Numerous species of forest trees at Ngoye exhibit the tropical forest character of cauliflory. Those noted include *Alchornea hirtella*, *Cassipourea gummiflua var. verticillata*, *Drypetes natalensis*, *Ficus capensis*, *F. quibeba*, *Halleria lucida, and Rapanea melanophloeos*.

Large, simple entire leaves are most common. "Drip tips" are found on most field and shrub strata species and the saplings and coppices of canopy trees. Typical "drip tips" are illustrated in Figure 6.

Unique features of Ngoye Forest

The great scientific importance of Ngoye lies in the link it forms between the tropical forests of Central and East Africa, and the temperate forests of Knysna and Tsitsikama. In addition to the large tropical element shown in floristic composition and physiognomy, the forest's scientific novelty is emphasized by a large endemic flora and fauna.

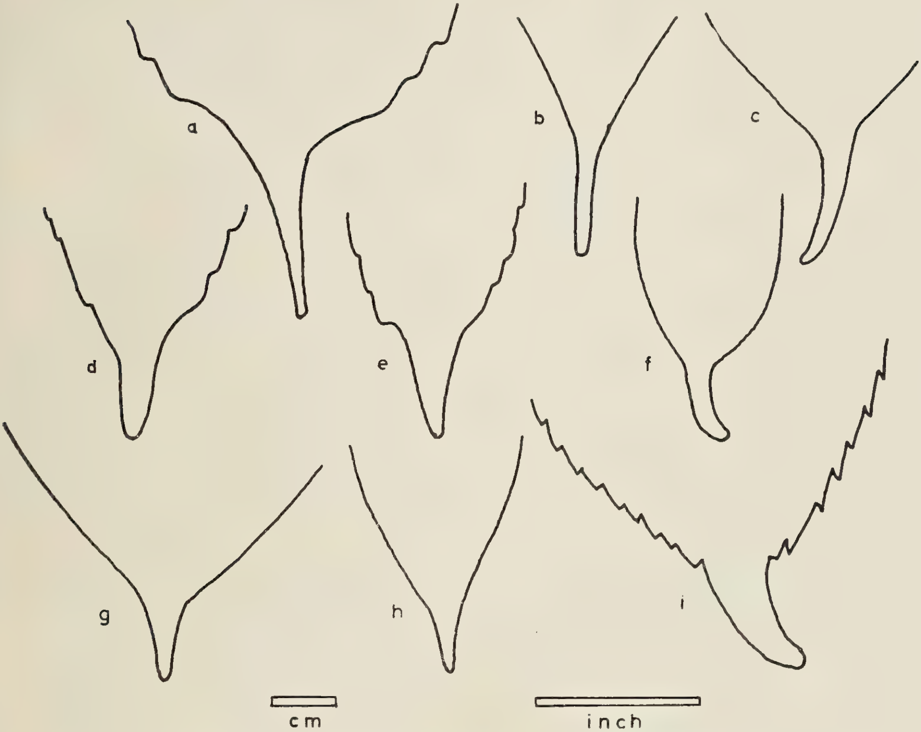

Fig. 6. Leaf apex outlines of typical "drip tips".
a. *Mackaya bella* b. *Rothmannia capensis* c. *Oxyanthus gerrardii* d. *Cassipourea gerrardii* e. *Drypetes gerrardii* f. *Ekebergia capensis* g. *Cassipourea gummiflua* h. *Bequaertiodendron natalensis* i. *Celtis africana.*

The distribution of animal and plant species of common occurrence at Ngoye, but which are very rare or absent elsewhere in South Africa, is given below.

Animals

Scientific Name	Common Name	S. African distribution	Distribution outside South Africa
Cormocephalus granulosus	Ngoye Centipede	—	—
Euryphera achlyus	Forest Green Butterfly	—	Chirunda Forest, S. Rhodesia
Paraxerus ornatus	Ngoye Red Squirrel	—	—
Buccanodon woodwardii	Green Barbet	—	Kenya, Tanganyika
Turturoena delegorguei	Delegorgue's Pigeon	Dargle; Pondoland (v. rare)	East Africa

Plants

Scientific Name	Growth Form	S. African distribution	Distribution elsewhere
Alchornea hirtella	short tree	—	Cameroons, Congo, Moçambique, Tanganyika, Zambia
Asplenium sandersonii	epiphytic fern	N.E. Transvaal	Rhodesia
Bolusiella maudae	epiphytic orchid	—	Kenya
Carissa wyliei	shrub	Port St. Johns	—
Corymborchis welwitschii	ground orchid	Port St. Johns	Moçambique
Encephalartos woodii	cycad (extinct)	—	—
Loranthus woodii	hemiparasite	—	—
Nectaropetalum zuluense	canopy tree	Oribi	—
Olyra latifolia	forest grass	Port St. Johns	Tropical Africa and America
Pseudobersama mossambicensis	canopy tree	Mangusi Forest (Kosi Lake system)	Kenya, Tanganyika, Moçambique
Stictocardia woodii	climber	Gwalaweni Forest (N. Zululand)	—

BIOTIC FACTORS

Animals

The animal ecology of Ngoye forest has not been studied in any detail.

Mammals

The mammalian fauna of the forest is very sparse due to poaching by natives from Native Reserve No. IX. Some of these people have rifles licensed in the days of the Natal Government, while many others have unlicensed fire-arms. Leopard are reputed by the natives to be responsible for occasional stock losses on the western margin. Until recently buffalo frequented the area and old pit traps are still to be seen.

The following mammals occur at the Reserve:

Nsamango monkey	*Cercopithecua mitis labiatus*
Vervet monkey	*Cercopithecus aethiops pygerythrus*
Chacma baboon	*Papio ursinus ursinus*
Bush baby	*Otolemur crassicaudatus garnetii*
Golden mole	*Amblysomys hottentotus*
Banana bat	*Pipistrellus nanus*
Fruit bat	*Rousettus leachii*
Ngoye red squirrel	*Paraxerus ornatus*
Mole rat	*Cryptomys hottentotus*
Tree hyrax	*Dendrophrax arboreus*
Red bush duiker	*Cephalophus natalensis*
Grey duiker	*Sylvicapra grimmia*

Bush buck	*Tragelaphus sylvaticus*
Bush pig	*Potamochoerus porcus*
Reedbuck	*Redunca arundinum*

Birds

The avifauna of the forest is both very interesting and prolific. A list of species occurring at Ngoye would be too lengthy to include in this report. As mentioned above, the occurrence of Delegorgue's pigeon and Woodward's barbet is particularly interesting from a zoogeographic viewpoint.

Seed Dispersal

The development of forest precursor communities and the regeneration of forest gaps formed by the death of old trees depends on the animal distribution of the edible fruits of light tolerant species, including *Antidesma venosum*, *Bequaertiodendron natalense*, *Bridelia micrantha*, *Canthium mundtianum*, *Diospyros lucida*, *D. lycioides*, *Erythrioxylum pictum*, *Eugenia natalitia*, *Ficus spp.*, *Flagellaria guineensis*, *Harpephyllum caffrum*, *Maesa lanceolata*, *Mimusops obovata*, *Rhoicissus tridentata*, *Syzygium cordatum*, *Trema guineensis*, and very many others.

Utilization of the Forest

The forest has long been the main source of timber available to the inhabitants of Native Reserve No. IX. Fernando (1912) considered this form of exploitation insignificant. Today, with the vastly increased population of the native reserve, the illegal extraction of timber by natives, especially on the seldom patrolled western margin, is becoming serious.

Exploitation of indigenous timber by Europeans includes that by John Dunn during the latter half of the nineteenth century. Fernando (1912) reports that slip paths used by Dunn were still evident in the 1910's.

Professor A. W. Bayer (personal communication, 1964) has stated that *Trichelia emetica* was extracted in the latter part of the 19th century and shipped via Port Durnford to a boat-building industry in Durban.

In 1909 the Ngoye Forest Company was granted a concession to extract certain indigenous timber trees from the Reserve. This Company established a mill alongside the forest, and constructed the few forest roads still in existence, but discontinued its activities within a few years. Extraction records are not available, but as far as can be ascertained, approximately 900,000 cubic feet of timber were removed, a good deal of which consisted of pit props for the Rand mines. (King, 1941).

The Forestry Department planted 14.1 acres to numerous introduced timber tree species for test purposes during the years 1912 to 1922. More

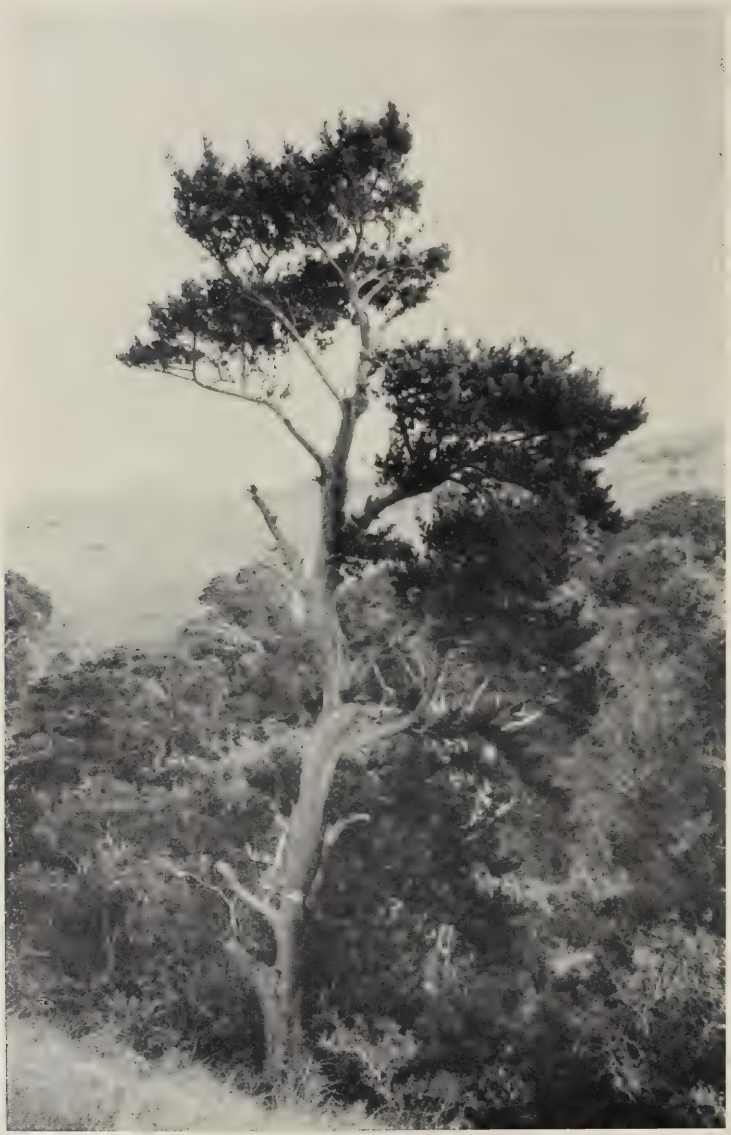

PLATE XXXIII
Damage to specimen of *Podocarpus latifolius* in Native Reserve No. IX. Large branches are periodically cut and dried for firewood.

recently one tenth of an acre has been planted to *Tectona grandis*, the Burma teak, also for test purposes. Since 1924 no further extraction of timber has been legally undertaken.

The feasibility of further afforestation must be considered. Of the 2,500 acres of grassland available to afforestation, not more than 1,000 acres would be accessible to vehicles without a very expensive road construction programme. Afforestation of any Reserve grassveld is not recommended. The grassland is in the first place needed by the natives for grazing and if afforestation did occur the strictest measures would be necessary to prevent deliberate firing of the plantations by the natives deprived of the use of these grasslands. Even if all the available grassland were made use of for afforestation, the area is too small to manage profitably, 3,000 acres being the minimum economic unit. (Mr. Francis, Regional Forest Officer, Zululand South, personal communication, 1964.)

Further, if Ngoye is to be maintained as a natural forest reserve, there is little logic in afforesting it with exotic timber trees.

Cattle, Goats, and Fire

During the past fifty years *Aristida junciformis* has replaced *Themeda triandra* as the dominant of the Ngoye Range Grasslands. The deterioration of the Grasslands may be attributed to two intimately related factors, irregular patch burning and uncontrolled grazing by cattle and goats.

Fires, started by inhabitants of Native Reserve IX to provide winter grazing, are retarded in their spread by numerous natural firebreaks such as streams, forested valleys, swamps and bornhardt outcrops. No rotational programme is followed, some areas being burnt several times per annum, others not for four or five years. The local Zulus regard grazing rights on the Ngoye Range as traditional, and are reluctant to pay the R1.20 per annum per beast levy. Patrolling of the rugged and extensive forest margin by two forest guards is difficult and much illegal grazing occurs in the western areas.

Where small patches are burnt, cattle and goats concentrate and graze the young shoots down to a stubble. Where the grazing pressure is not intense the more palatable species are selectively grazed, and the sour species, due to reduced competition, can multiply more rapidly. Invasion of *Aristida junciformis* into the mixed grassveld of the Reserve results from these factors, and may be seen most clearly near footpaths where most burning occurs.

Transition from grassland to forest on the sinuous 57 mile margin is sharp due to the absence of forest margin seral communities. Destruction of these communities is attributed to the factors responsible for the deterioration of the grasslands, and is accelerated by trampling and browsing by cattle and goats.

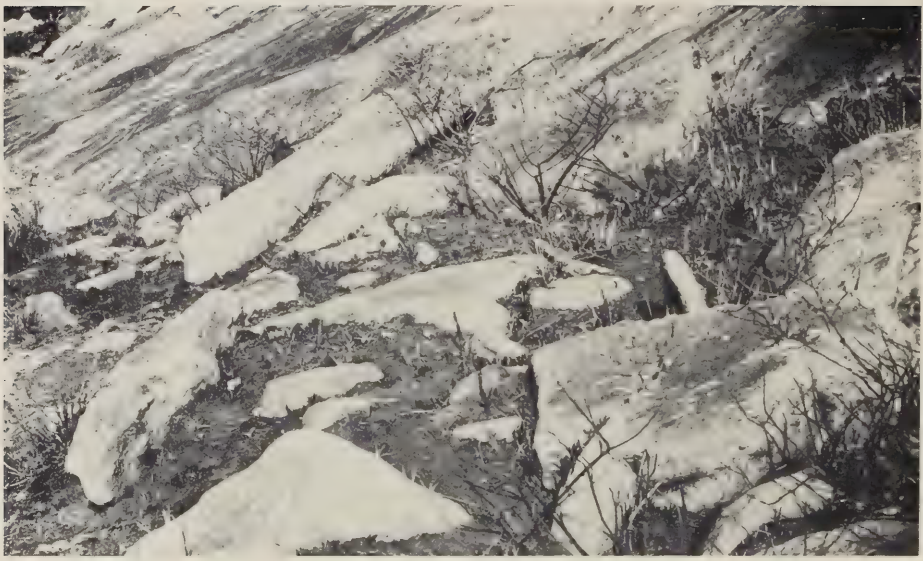

Plate XXXIV
Fire damage to scrub and herb community of rock outcrop. July 1964.

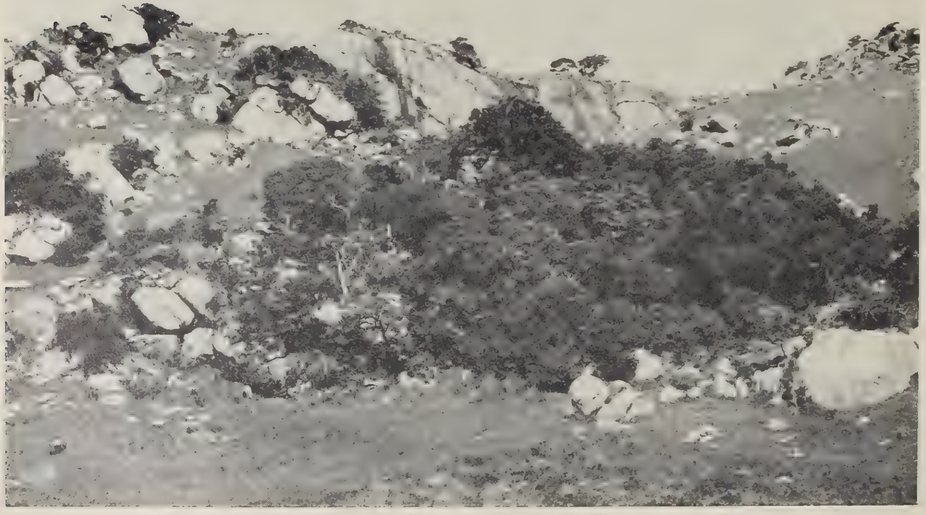

Plate XXXV
Forest patch protected from fire by rock outcrops. Note the cattle grazing and browsing on the margin.

Plate XXXVI
Cattle grazing and browsing on forest margin. The tallest trees, up to 55 ft. are *Millettia sutherlandii.*

Absence of forest marginal communities not only prevents further development of forest, but removes the protection they would afford the forest trees from hot, dry, north-east winds.

In order to prevent further retreat of the forest margin, Taylor (1963) with reference to the Nxamalala Forest, recommends afforestation of the marginal grasslands. This is impractical at Ngoye as expressed above. It is suggested that firebreaks be maintained across the mouths of tongues of grassland that extend into the forest. This measure would at least protect some of the margin from fire and would allow the marginal communities to develop and eventually close the gaps.

THE FUTURE OF NGOYE

Before the management of the Reserve is discussed it is necessary to consider the future status and utilization of the forest. Four possibilities exist:

1. To continue the present system of management, with two African Forest Guards controlling 9,648 acres; and to allow deterioration of the grasslands, forest margin and forest, to continue.
2. To hand the administration of the Reserve over to the Bantu Authorities for disposal as they think fit.
3. To afforest the grasslands and manage the Reserve for its timber value.
4. To conserve the Reserve as a Scientific Research Area.

The first possibility mentioned above is clearly untenable. Regarding the second, the contention that the rural Bantu will value and preserve indigenous forests handed over to them, is pure fallacy. The destruction of remnant forest patches in Native Reserve No. IX illustrates this point. The inhabitants are using the timber for domestic purposes, and the rich but short-lived soils of

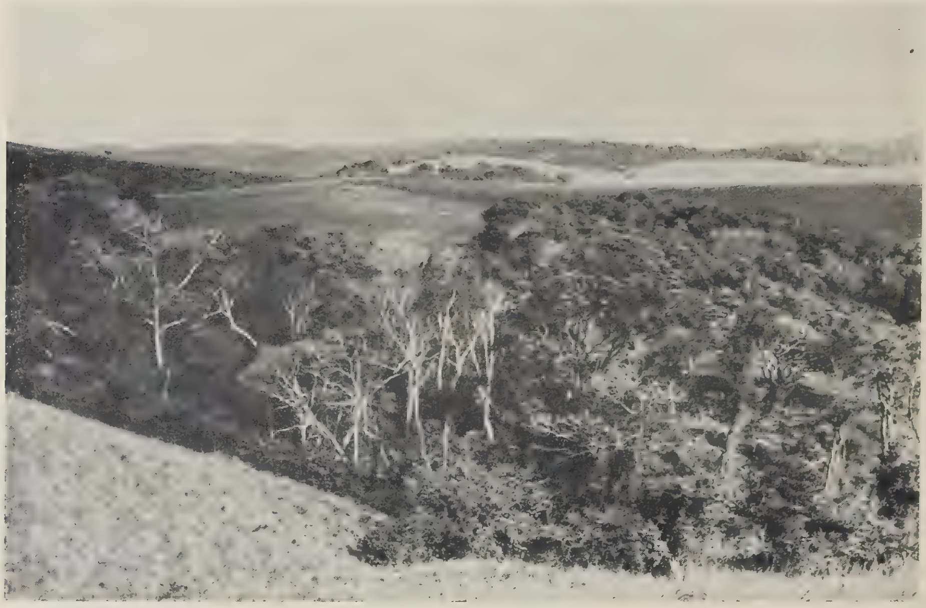

PLATE XXXVII
Forest patch in Native Reserve No. IX being cleared of undergrowth for crop cultivation. July 1964.

cleared areas for crop growing. The impracticability of afforestation of the grasslands has been discussed under Biotic Factors. The fourth possibility must be discussed in greater detail.

From a scientific viewpoint Ngoye Forest is of inestimable value. The unique flora and fauna of the Reserve has been described above. Ngoye is undoubtedly the most valuable forest in Natal from phyto- and zoogeographic considerations. It links the tropical elements of forests in Mocambique with the sub-tropical and temperate forests of Pondoland and Knysna. No other forest in Natal has as many endemic and tropical species as has Ngoye.

The socio-economic importance of conservation is concisely and excellently discussed by F. F. Darling (1964, p. 39) to which I refer the reader. Where unwise management results in deterioration of the human habitat it is vital to have a conserved area for comparison to assess the extent of degradation. The grasslands of Ngoye illustrate this point. As mentioned above, the Native Reserve Grasslands have been reduced from productive *Themeda triandra* to useless *Aristida junciformis*, the only remnants of *Themeda triandra* on the range occurring in the better protected parts of the Forest Reserve.

Were it not for Forest Department protection of a representative area of the district, the entire region would today be dominated by *Aristida junciformis* without a hint of the area's potential as *Themeda triandra* Grassland. That conservation of Ngoye Forest Reserve has to date been of great value to the human population of the area has not yet been appreciated. This value can only be made real to the human population if practical eco- agricultural methods, based on studies in the Reserve, are implemented.

It must be remembered that the Reserve is surrounded by Native Reserve No. IX. Any management programme should avoid unnecessary friction with the inhabitants of the native reserve. Restricted grazing and the cutting of thatch grass should be permitted at a nominal cost. Poaching on the periphery of the reserve is especially difficult to control, but it may be borne in mind that, with the possible exception of the Ngoye red squirrel, the rarer plants and animals of the forest are not used by the natives and therefore do not require special protective measures. The management of the reserve as a scientific research area would not necessitate the fencing of the boundaries or discontinuation of grazing. Selected areas may need complete protection for study purposes, but in general the standard of living of the local native could only be improved by scientific studies regarding vegetation management at Ngoye.

The recommendations discussed below may be implemented at very small cost, and would serve as a base for conservation of the Reserve as a Scientific Research Area.

The repair of the old Ngoye Timber Company road to the Forest Guard Camp is necessary, primarily for the easy access of fire-fighting or poaching control teams in emergencies, but also for the transport of scientific recording materials to the forest. The rights of way through the forest used by the local natives should also be more clearly defined.

Where necessary the existing corner and line beacons should be repaired. Further line beacons should be placed at a maximum of 500 yard intervals and a 30 yard wide firebreak should be maintained to demarcate the boundary more clearly.

The present Forest Guard Camp is in bad repair and the erection of permanent married quarters for two Forest Guards is necessary. At least one camp must be established in the extreme west of the Reserve. The grazing and grass-cutting levies should be revised and, if necessary, strictly enforced at the earliest convenience, foregoing retrospect payments.

The policy of any burning programme should be to avoid the deleterious effects of patch burning or intense fires following long fire-free periods. In regard to the grasslands, regular extensive spring burning is suggested. Accidental fires should be allowed to burn at least one hundred acres but should, if possible, be prevented from entering forest margin communities.

Self-recording weather stations should be established at suitable points on the Ngoye Range at the earliest opportunity. Such recordings are essential for any long-term scientific project conducted at the Reserve.

In addition to the establishment of permanent Forest Guard Camps, it would be a great advantage to erect simple accommodation, in the form of a rondavel, for visiting scientists and officials.

It is essential that the entire Ngoye Forest Reserve, as proclaimed in 1913, be conserved in perpetuity. The reduction of its size should never be allowed, for not only is its area of insignificant proportions in relation to the size of Zululand, but the reduction in size of any natural community is ecologically undesirable. A short passage from F. Fraser Darling (1960, p. 56), is appropriate.

"A natural habitat, especially a forest which depends to some extent upon the interior temperature-humidity relationship, must exist unbroken over a considerable area if it is to survive and regenerate; this is one of the axioms emerging from greater understanding of the structure and physiology of ecosystems, and one which must be learnt by governments in apportioning land and devising land use programmes."

ACKNOWLEDGEMENTS

I am sincerely grateful to all those people who have aided me in the preparation of this report. Foremost I must thank Mr. I. F. Garland and Mr. K. H. Cooper for introducing me to this unique forest.